nearly equal amount of kinetic energy is generated in the smaller mass passing (with high velocity) through the narrowing sectional area under the edge of the gate. Here the compression of the water is not considered, the pressure being small; as is shown by the fact that neither the modulus of elasticity (of volume) nor the velocity of sound enters the equation employed. It would have been well to remind the student at this point that in the gradual closing of a stop-gate, if the motion of the gate is uniform the rate of retardation of the water can not be uniform, and that the pressure induced just behind the gate is consequently variable and reaches a maximum value which may be many times as great as the average pressure (which average is equal to the pressure produced when the gate is so managed as to make the retardation uniform, the whole time of closing remaining unchanged).

As to the discussion of the impact of a jet upon a flat plate or vane (p. 378), one cannot help thinking that it would have been preferable to substitute for this rather lengthy and involved treatment (where the reader must be uncertain whether the plate is furnished with borders parallel to the paper or not) the simple and direct analysis given by Rankine in Case V. of § 144 of his 'Steam Engine and Other Prime Movers' (also given by Cotterill).

On page 500, in the theory of the turbine, the term 'velocity of flow' is used in a sense entirely different from that specially defined on page 498; and on the same page (500) obscurity of language results from the apparent statement that impulse equals momentum (instead of change of momentum).

The author is evidently (p. 96) of the same opinion as Collignon (see 'Hydraulique,' p. 146) when he designates as 'gratuitous' the assumption that in the case of a flat-topped weir the flow adjusts itself to such a depth on the weir as to bring about a maximum discharge. Several authors have noted that experiment gives results not very wide of this relation. Unwin (p. 472, article 'Hydromechanics, Encyclop. Brit.) is rather non-committal on this point, though giving the same analysis; whereas Mr. J. P. Frizell (see *Engineering News* of September 29, 1892) is plainly of the opinion that the flow should theoretically adjust itself to a maximum discharge.

I. P. CHURCH.

Dragons of the Air, an Account of Extinct Flying Reptiles. By H. G. SEELEY, Professor of Geology in King's College, London. London, Methuen & Co.

When so accomplished a student of extinct life as is Professor Seeley writes in so pleasing a way as he has of a group of animals to which he has devoted many years of study, the results can only be happy. Divested so far as is possible of technicalities, accurate in statement, lucid in presentation, and enriched by patiently gathered facts from many sources, his present work upon the 'Dragons of the Air' summarizes for the paleontologist, as well as for the general reader, about all that is known of those strange fossil reptiles called pterodactyls or ornithosaurs. The book contains a discussion of reptilian characters, the range and distribution of pterodactyls, a review of the known forms, and a thorough comparison of them with other vertebrated animals, part by part, a history of their development, inferences as to their habits, and conclusions as to their place in the animal kingdom.

It is illustrated by many figures and plates of the bones or skeletons of pterodactyls and allied animals, and by many restorations of the creatures as the author and others have conceived them. In a few words, the work, while popularized, is a critical review of this extinct order of reptiles from many sides, interesting because of the strangeness of the animals and valuable to the student of vertebrate morphology, as well as to the geologist.

However, with the fullest respect for the author's anatomical erudition and admitting the force of his reasoning in many cases, the present writer can not always agree with his conclusions. To review them all would be out of place here; the curious reader may expect a wider discussion elsewhere. Many of the bird-like or mammal-like characters which he sees in the pterodactyl, Professor

Seeley would ascribe to ancestral, fundamental impressions, and not to adaptation. The present writer believes that the elongation of the wing finger, the progressive weakening of the middle fingers and the peculiar shape of the first finger are all purely adaptive, together with the shape of the humerus, the peculiar form of the sternum, the anchylosis of bones, the shortening of tail and concomitant increase in length of the sacrum, the diminution and loss of the fibula, the loss of teeth, retreat of the nostrils, etc. The bone in the lizard commonly called the squamosal extends to, or nearly to, the brain surface in the mosasaurs. If the determination of the bone be right, this character loses its value as an avian index in the pterodactyls; if wrong, there is the same possibility in the pterodactyls. *Dimorphodon* had the fifth toe peculiarly modified for the sustentation of the patagial membrane. What good reason then has Professor Seeley for supposing that this specialization was lost in later forms; that the membrane was restricted to the sides of the body only? The rudimentary fifth toe in *Ornithostoma* was divergent. What use had it unless that of *Dimorphodon?* In bats the membrane extends to the ankle and over the tail. It is reasonable to suppose that such were its relations in all the pterodactyls, the later as well as the earlier.

Especially does the writer disagree with Professor Seeley in his opinion that the quadrupedal position of the body in ambulation was a normal one. He doubts very much whether the peculiar articulation of the humerus would permit such a position of the bones in some of the pterodactyls. And what use were the loosely attached middle fingers of some pterodactyls as ambulatory organs? In a specimen of *Ornithostoma* recently acquired by the University of Kansas, the small fingers are in position, from which it is evident that they could not have been brought to the surface of the ground in a state of pronation. Nor does it seem reasonable that the animals walked upon the knuckles of the fifth fingers. In those animals in which the body is carried more or less erect, as in birds and dinosaurs, there occurs elongation of both sacrum and ilium. In the early pterodactyls there were three or four sacral vertebræ; in *Nyctodactylus,* one of the latest, there were six true sacral vertebræ and one coossified lumbar. It thus would seem that some or all pterodactyls walked erect when upon the ground, with the knees probably much flexed. The pelvis of *Nyctodactylus,* with an expanse of outstretched wings of fully eight feet was less than seven eighths of an inch in diameter at the brim, and not three fourths of an inch at the outlet. The heads of the femora in the largest species measuring twenty feet in expanse were less than two and a half inches apart. If the legs were knock-kneed, as seems probable, both of the feet in such animals would have rested upon a space smaller than one's hand. In the posture I have indicated, with the body erect, the wing metacarpal bones would have rested upon the ground at the sides.

The eggs of *Nyctodactylus* could not have been three fourths of an inch in diameter, and of *Ornithostoma* not over two inches. How big would the young have been recently hatched from such eggs? Were they cared for by their parents after birth? Did the pterodactyls build nests?

S. W. WILLISTON.

PAPERS ON ENGINEERING.

The *Proceedings* of the Royal Society, just issued (Vol. XVI., Part II., Lond., Nov., 1901), contain a number of papers of peculiar interest in the field of applied science and engineering.

The opening article is by Lord Rayleigh, on 'Flight.' In this paper it is stated that the main problem in flight is that of the aeroplane, as in the case of the kite. But the kite is anchored and at rest relatively to the earth; while the aeronaut, the aviator, whether human or other, is adrift. No bird can maintain itself in motion in a uniform wind-current without active exertion, any more than in an atmosphere at rest. Soaring is thus evidently the outcome of utilization of internal movements of the atmosphere surrounding the bird. The albatross presumably takes advan-